Aggregating collective judgment in scientific research

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Abstract

A scientific theory can be roughly characterized as a collective endeavor aiming at finding true explanatory principles in a given area. An important feature of this collective endeavor is that it is made of individuals belonging to various and not necessarily overlapping generations. How can and should these generations collaborate to maximize their chances to discover and accept correct explanatory principles ?

The theory of judgment aggregation seems like a perfect framework in which to investigate this question : broadly understood, this theory seeks to find out how a group of individuals could produce judgments or decisions that outperform the capabilities of their individual members. This effort to design aggregative procedures must meet two challenges : the coherence challenge and the correspondence challenge. The first one originates in the problem of inconsistent majority judgment, “the discursive paradox” (List, 2011). The second challenge stems from Condorcet's jury theorem (List, 2010). In my paper, I want to address the ability of scientific research to meet this second challenge : is there a procedure of intergenerational judgment aggregation that will result in more reliable theories than those that would have been produced by each researcher working individually ?

At first glance, scientific communities fit perfectly into this mold. Sociological and cognitive descriptions of these communities (Knorr-Cettina, 1999) (Giere, 2002) have recently been construed within this framework (List, 2010), and in particular through List's theorem : in groups confronted with several propositions and where individuals have different areas and levels of expertise, there is a level of individual expertise in a given area that leads to a higher probability of truth when these individuals are distributed among specialized committees, here understood as the communities described by Knorr-Cetina (1999).

However, science is not only a sociological phenomenon, but also an historical phenomenon, i.e. an intergenerational process of cooperation. Therefore, to be applied to scientific research, the theory of judgement aggregation must meet the following condition : the aggregation of the judgements of individuals belonging to different periods must produce judgements whose probability is higher than that one of each one of these judgements taken separately.

We can distinguish three consequences of this intergenerational feature of scientific practice : (1) the creation of new questions (Jardine, 1991); (2) the extension of empirical knowledge through technological innovations (Shapere, 1998); (3) the apparition of new hypotheses. From our standpoint, the first feature is not relevant since we are seeking how to aggregate judgments concerning a defined question. The second feature might be more interesting for us ; but one could easily extend the existing theory of judgement aggregation in order to integrate this aspect of science. To that end, it is only necessary to consider each generation as being endowed by their technological knowledge with a different level of expertise. We can use the distributed premised-based procedure and attribute the highest level of expertise to the present generations and the lowest to the past generations. It could follow from this model that past generations do not have to be taken into account in the aggregation procedure.

I claim that the third feature could be an impediment to the generalization of the theory of judgment aggregation to scientific practice. Kyle Standford (2004) has recently has highlighted this

aspect of history of science and labeled it " the problem of unconceived alternatives". To put it in a nutshell, Stanford shows that a defined generation of researchers is not able to imagine all possible relevant hypotheses, i.e. all possible answers to a given question. This inability can be traced back to our limited cognitive capabilities but also to the social inheritance of preformed concepts (Thagard, 1992) : without conceptual revolutions, new hypotheses can not be conceived.

This characterization of social practices seems to disqualify the aggregation judgment approach for three reasons. First, it entails an important difference between the background assumptions describing a collective judgment situation and any scientific judgment situation : whereas the former supposes that the hypotheses are already given to the individuals by an "ideal interviewer," scientific agents have to produce independently these possible answers. Second, the existence of unconceived alternatives lowers the individual probability of making true judgments : since the number of possible cases is substantially increased, the rate of systematic error increases so much as to be lower than 0.5. At that point, the Condorcet majority theorem states that the aggregate judgment will be incorrect. Third, there is an asymmetry between probabilistic limitations in judgment formation and social and cognitive limits to our imagination : whereas one individual can always express a judgment, once he has been provided with a question and a set of possible answers, his imagination either works or not. Therefore, the aggregation of all the hypotheses conceived within a group of individuals is not necessary since its outcome would be strictly equal to the set of hypotheses conceived by a few imaginative people.

In my paper, I intend to extend the aggregation judgment theory to scientific research by offering an aggregation procedure that meets the challenges that follow from Stanford description of intergenerational relationships within scientific communities.

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